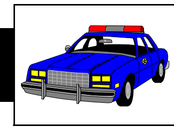
UNIT 7: MICHIGAN TRAFFIC LASER



Unit Overview

7.1 Unit Instructions—Scope and Objectives

A. Instructions

1) Read the entire unit.
2) Complete the Unit 7 review and instructional activities in Section 7.14, and check your answers using the answer key in Section 7.15.
3) Complete the unit evaluation form.
4) Mail the unit evaluation forms to MJI when you have completed all units.

B. Scope and Objectives

This unit describes the use of laser speed-measurement devices by Michigan law enforcement agencies in their issuance of speeding tickets. It discusses the principles of laser speed measurement, the components and their functions, the process of verification, proper operation, the process for certification of operators, and guidelines for adjudication of traffic laser citations.

The content of this unit was taken from the instructional training program developed for Michigan laser operators. That program was designed by members of the Michigan Speed Measurement Task Force (MSMTF).

After completing this unit, you will be able to:

- Identify the principles on which traffic laser speed measurement devices operate.
- Understand the characteristics of laser beams.

- Identify the different kinds of laser devices and how they work.
- Explain the guidelines for adjudicating laser speeding cases.
- Identify the steps required to verify that a laser instrument is in proper working order.
- Identify the procedures for setting up and operating a laser speed measurement device.
- Accurately determine whether the laser instrument and the operator meet the standards set.

7.2 Overview and Introduction

In 1991, a laser technology first used to help space vehicles dock was applied to earthbound civilian vehicles. This laser instrument is known as LIDAR (Light Detection and Ranging), most commonly called a laser speed measurement device (LSMD). LSMDs operate on the “time of flight” or “Time-Distance” principle. The laser devices transmit hundreds of infrared light pulses at a moving object. Since the speed of light is known, it is possible to ascertain the distance of an object by the time it takes for a beam to bounce off an object and return. Changes in that distance provide the vehicle’s speed. This computation is based on an average of hundreds of laser light pulses hitting the object in a fraction of a second.

When LSMDs first became available to the general law enforcement community in 1991, it became apparent that the laser devices had some significant advantages over other speed-measurement technologies for certain enforcement situations. As private commercial manufacturers began to market LSMDs to law enforcement agencies, a growing number of agencies within Michigan expressed an interest in using these devices. As a result, the Michigan Speed Measurement Task Force (MSMTF) studied the central issues surrounding these devices, and made a determination that traffic LSMD operator training and certification were required.

Since the vast majority of those wishing to become certified laser operators were MCOLES-certified radar operators, the MSMTF concluded that the update training of existing certified radar operators would be the best approach for meeting the needs of the law enforcement community. The training required for laser devices represents a minor extension of the knowledge and skills that certified radar operators have already acquired through their prior training and experience with radar devices.

The Supplemental Traffic Laser Operator Training Course was developed by the MSMTF at the request of the Michigan Commission on Law Enforcement Standards (MCOLES). The laser operator training curriculum and testing instruments were validated during pilot testing in 1993 by the Michigan State Police and Michigan State University. Since August 7, 1993, all currently certified traffic radar operators who wish to be certified to use LSMDs must successfully complete this training course and be certified by MCOLES as a prerequisite to being allowed to testify in any court hearing involving laser speed measurement.

Asof March 1, 2000, each new laser speed measurement device purchased for use in Michigan shall meet the standard set by the International Association of Chiefs of Police. Each manufacturer will provide the purchasing agency with a Michigan "Certificate of Compliance," assuring testing and compliance to the IACP standard.

The MSMTF recommends that it is not necessary to have these devices periodically recertified because a properly trained operator will be able to determine when a specific device is malfunctioning.

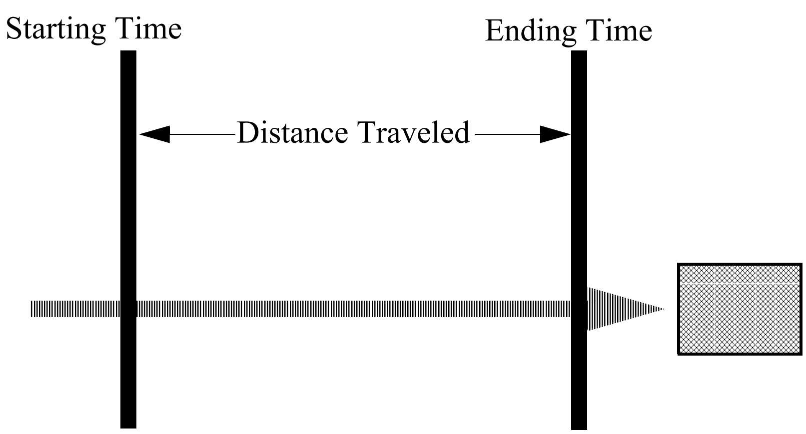
7.3 Time-Distance Principle

The Time-Distance Principle is the basic law at work when using a LSMD.

Speed is a physical quantity that measures the rate that an object moves. For motor vehicles, we measure the speed in miles per hour (mph). To measure the speed using the time-distance principle, we need to know two quantities: the distance traveled and the elapsed time it took to traverse this distance. Speed may then be calculated as follows:

$$\text{SPEED} = \frac{\text{Distance Traveled}}{\text{Elapsed Time}}$$

TIME-DISTANCE PRINCIPLE



$$\text{Elapsed Time} = \text{Ending Time} \angle \text{Starting Time}$$

Example:

$$\text{SPEED} = \frac{660 \text{ feet}}{7.5 \text{ seconds}} = 88 \text{ feet per second}$$

To convert feet per second to miles per hour, the following formula is used:

$$\text{mph} = \frac{\text{feet/second}}{(5{,}280 \text{ feet/mile}) \div (3{,}600 \text{ seconds/hour})}$$

$$\text{mph} = \frac{\text{feet per second}}{1.4666}$$

Using the example above, 88 feet per second would be converted to miles per hour as follows:

$$\text{mph} = \frac{88 \text{ feet second}}{1.4666} = 60 \text{ mph}$$

7.4 Laser Beam

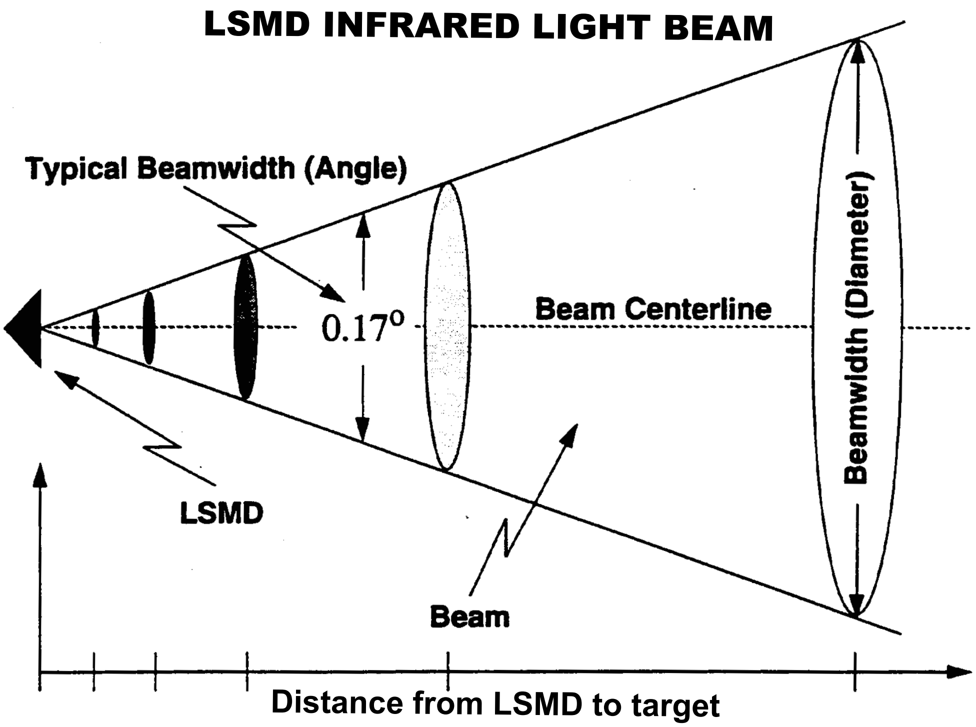
A. Laser Light

All electromagnetic waves, including light from a laser, travel at the speed of light or 186,000 miles per second. Light waves are similar to radio waves and microwaves. The principal difference is that light has a much higher frequency.

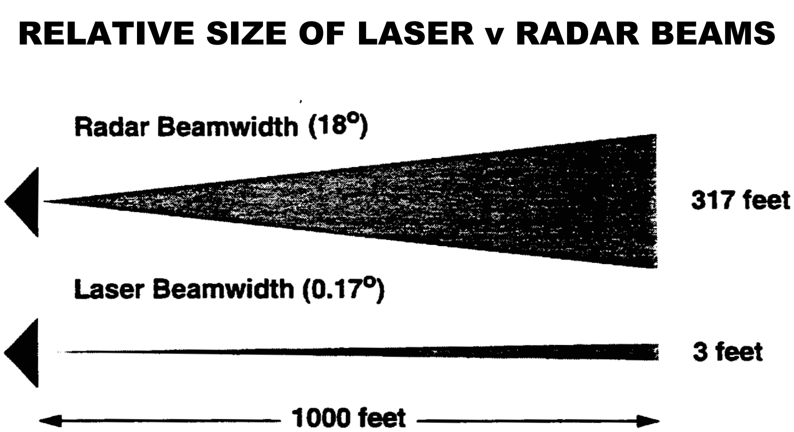
The word “laser” is an acronym for Light Amplification by Stimulated Emission of Radiation, which describes the physical principle that is utilized to generate laser light.

B. Beam Characteristics

A laser beam is conical in shape and is similar to a flashlight’s light beam, except that its beam is quite narrow and it contains infrared light. All of the light energy is contained in the beam, and this energy spreads out over an ever larger area as the distance along the centerline of the beam increases.



The width of the laser beam can be measured as the angle of the beam and is typically between 0.15 and 0.20 degrees. This is approximately 1% of the beam width of an X-band or K-band radar device.



Because of this extremely narrow beam, an operator using a down-the-road laser device is able to select between two vehicles that are in adjacent lanes of traffic and select one as the specific target.

LSMD BEAMWIDTH v RANGE

(Assumption: Beamwidth = 0.17 Degrees)

Target Range (feet)	Beam Width (inches)	Relative Size of Beam
50	1.8	Wristwatch
100	3.6	
200	7.2	Headlight
400	14.4	
800	28.8	Stop Sign

The intensity of the beam of light is greatest right at the point where the beam exits the laser device. If the light intensity is high enough, it can damage the eye. However, all of the laser speed-measurement devices approved for use in Michigan are classified as eye safe. This means that the maximum intensity is sufficiently low that there is no known health risk, even if a person looked directly into the beam continuously.

The light emitted from the LSMDs is in the infrared region of the electromagnetic spectrum and is invisible to the human eye. Special infrared viewing goggles are needed to see the light. This invisible light will not distract motorists.

C. Difference Between Radar and Laser Speed Measurement

As was discussed in Unit 6, traffic radar uses the Doppler effect to measure velocity. A radar unit bounces a continuous beam of radio microwaves at a moving object. Speed is determined as the source and the object approach each other or move apart. Frequency of waves increases when the two approach each other or decreases as they move apart.

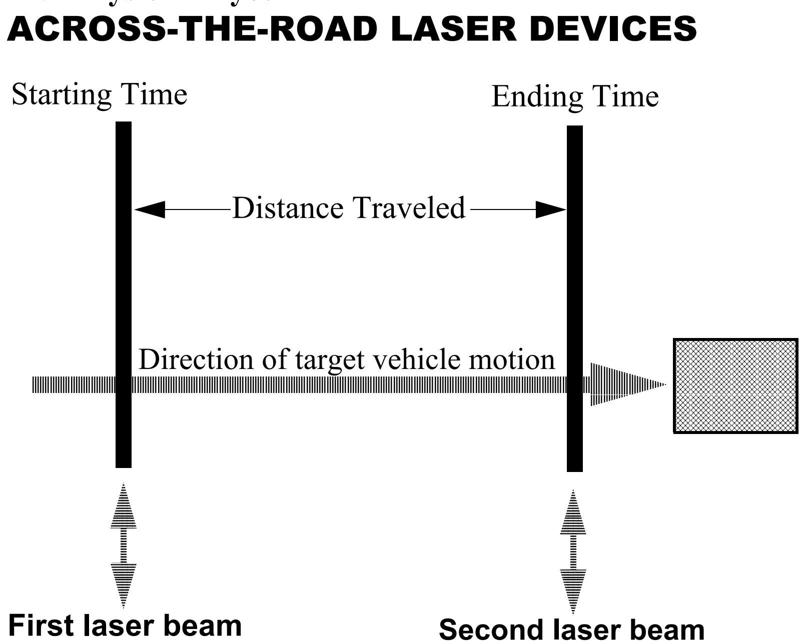
LSMDs emit a very narrow infrared pulse beam, amounting to approximately 4 feet in width at 1,000 feet. The radio microwave beam, on the other hand, can be very wide, as much as 316 feet at a distance of 1,000 feet. The narrowness of the light beam makes it much easier than with radar to single out an individual vehicle. LSMDs currently must be operated from a stationary position, unlike conventional radar which can be operated from a moving vehicle.

7.5 Types of Laser Speed Measurement Devices

There are two types of LSMDs: across-the road laser devices and down-the-road laser devices.

A. Across-the-Road Laser Devices

1. Physical Layout



2. Laser Light Sources

When using across-the-road laser devices, there are two laser light sources. Both of these laser light sources continuously transmit beams of light. The beams are parallel, with a fixed separation distance. The two beams are directed perpendicular to the flow of traffic.

3. Laser Light Detectors

Two light detectors are permanently mounted near each of the lasers and detect laser light reflected back from vehicles that cross through the laser beams.

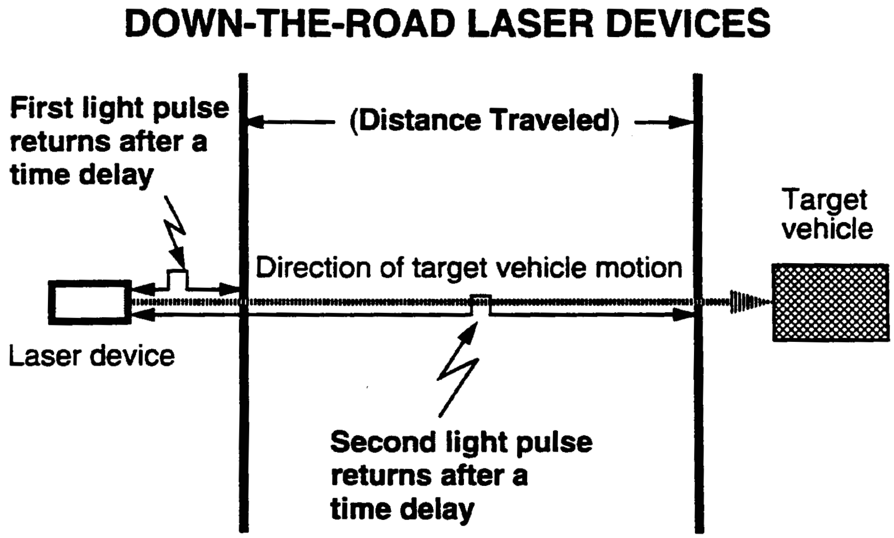
4. Measuring Vehicle Speeds

The LSMD monitors the elapsed time that it takes for the front (rear) edge of the vehicle to pass from the first laser beam to the second. The distance traveled is the distance between the two parallel laser beams. The target vehicle speed is then measured using the time-distance principle:

$$\text{SPEED} = \frac{\text{Distance Traveled}}{\text{Elapsed Time}}$$

B. Down-the-Road Devices

1. Physical Layout



2. Laser Light Sources

When using down-the-road laser devices, there is one laser. It transmits pairs of short time duration pulses of light. The beam is directed down the road, parallel to the motion of the target vehicle.

3. Laser Light Detector

A light detector is permanently mounted near the laser and detects the laser light reflected back from stationary or moving objects.

4. Measuring Vehicle Speeds

Pairs of light pulses are used to measure the speed of a moving target vehicle by applying the time-distance principle to determine how far the vehicle travels in a known amount of time. The first pulse is transmitted at an instant in time – the starting time. After some time delay, a reflected pulse returns to the light detector. The measured distance of the target vehicle to the LSMD is computed.

Next, the second pulse is transmitted at an instant in time – the ending time. Again, after some time delay, a reflected pulse returns to the light detector. The measured distance of the target vehicle to the LSMD is then computed.

The elapsed time it takes for the target vehicle to travel between these two measured distances is simply the difference between the starting time and the ending time. Once the distance traveled and elapsed time have been computed, the speed is computed using the time-distance principle:

$$\text{SPEED} = \frac{\text{Distance Traveled}}{\text{Elapsed Time}}$$

C. Summary of Down-the-Road LSMD Speed Measurement Principle

1) The LSMD transmits and receives pairs of light pulses.
2) The first pulse is transmitted and returns after a time delay.
3) This time delay is used to compute the distance between the LSMD and the target vehicle.
4) The second pulse is transmitted and returns after a time delay.
5) This time delay is used to compute the distance between the LSMD and the target vehicle.
6) Once this second distance is computed, the total distance traveled is computed. Specifically, the total distance traveled is the distance between the first distance and the second distance.
7) The time interval between the transmission of the two light pulses is known and represents the elapsed time it took the target vehicle to travel between the two measured distances.
8) The LSMD stores the distance traveled and the elapsed time and automatically computes the measured target-vehicle speed using the time-distance principle.
9) The measured target-vehicle speed is simply then the ratio of the distance traveled to the elapsed time, i.e., measured speed equals the distance traveled divided by the elapsed time to travel the distance.

7.6 The Michigan Speed Measurement Task Force Guidelines

As of February 1, 2003, there has not been an appellate court ruling in Michigan related specifically to cases involving laser speed measurement devices. Although *People v Ferency,* 133 Mich App 526 (1984) deals with the adjudication of a case involving traffic radar, the MSMTF is of the opinion that the principal recommendations set forth in that ruling can also be applied to cases involving LSMDs. The guidelines for adjudicating speeding cases involving laser speed measurement devices that have been developed by the Task Force reflect this opinion.*

**People v Ferency* is discussed in Section 6.7.

The Interim Michigan Speed Measurement Task Force Guidelines are as follows:

1) The officer operating the laser speed measurement device must have adequate training and experience in its operation.
2) The particular laser device must have been certified for use in Michigan as determined by the Michigan Speed Measurement Task Force.
3) The laser device must be verified in the same manner at the beginning and end of the shift to ensure that it is in proper working condition, and

the device must be serviced by the manufacturer or other professional as recommended.

4) The officer using the laser device must be able to testify that a down-the-road speed reading was obtained at a distance that was within the operational range for the device.

5) The target vehicle must be properly identified.

6) The laser device must be in proper working condition at the time the speed measurement is obtained. Additionally, across-the-road laser devices must be properly positioned and aligned.

7.7 Verification of Laser Speed Measurement Devices

*See the discussion at Section 7.6.

The Michigan Court of Appeals ruling in *People v Ferency*, 133 Mich App 526 (1984), sets forth seven guidelines that courts must follow to protect the defendant's due process rights in a speeding case involving "moving" radar. The *Ferency* guidelines were used as a basis for the Michigan Speed Measurement Task Force Guidelines for use of laser devices.* Two of these laser device guidelines relate to LSMD verification:

1) The LSMD is in proper working condition and properly installed at the time of the issuance of the citation.

2) The LSMD must be retested at the end of the shift in the same manner that it was tested prior to the shift and the LSMD must be serviced by the manufacturer or other professional as recommended.

The following discussion explains the steps taken to meet these two guidelines.

A. Verification Steps

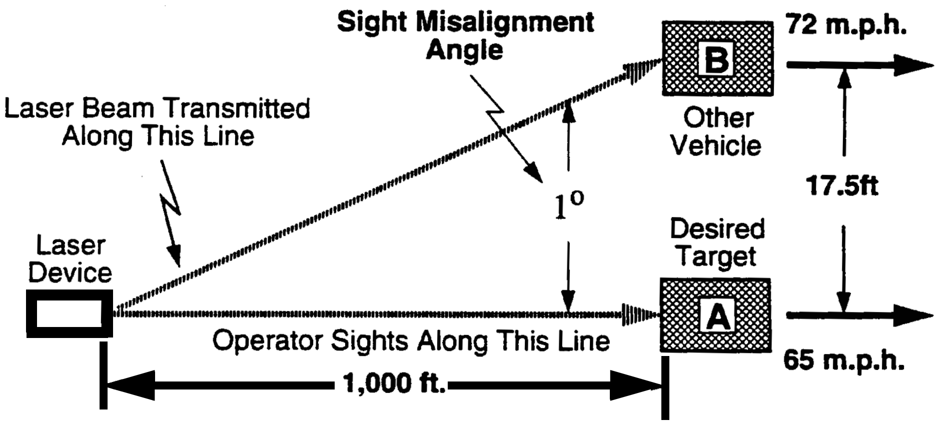
1. Beam Alignment for Down-the-Road Devices

Requirement: For down-the-road devices, the operator must verify that the transmitted laser beam and other target-sighting optics are in proper alignment.

Rationale:

- The laser beam is invisible and has a very narrow beam width.
- The LSMD must possess a means — such as a sighting scope — to enable the operator to direct the beam to a specific target vehicle.
- If the transmitted laser beam and the target-sighting optics are misaligned, the operator could be sighting one vehicle while the laser beam is being directed to another nearby vehicle.

MISALIGNMENT OF DOWN-THE-ROAD BEAM



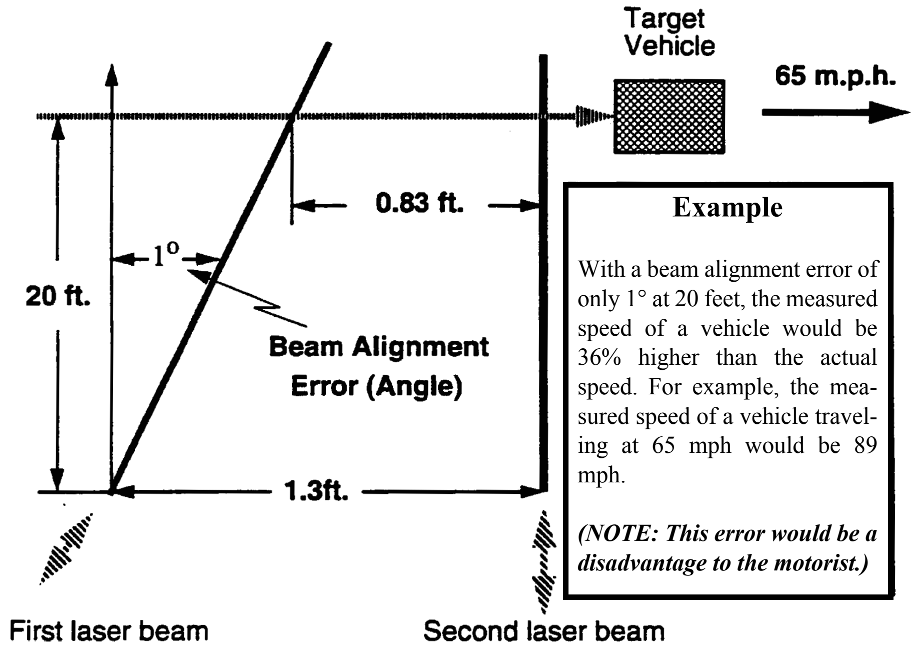
2. Beam Alignment for Across-the-Road Devices

Requirement: For across-the-road devices, the operator must verify that the transmitted laser beams are parallel to each other and perpendicular to the direction of traffic flow.

Rationale:

- The laser beams are invisible and have very narrow beam widths.
- If the beams aren't parallel, then the actual distance traveled by the target vehicle can be less than the distance anticipated by the computational circuitry within the LSMD.
- This can lead to an inaccurate speed measurement since the actual vehicle distance traveled will be greater or less than the LSMD measured distance.

MISALIGNMENT OF AN ACROSS-THE-ROAD BEAM



Example

With a beam alignment error of only 1° at 20 feet, the measured speed of a vehicle would be 36% higher than the actual speed. For example, the measured speed of a vehicle traveling at 65 mph would be 89 mph.

(NOTE: This error would be a disadvantage to the motorist.)

3. Operational Range for Down-the-Road Devices

For down-the-road devices, the MSMTF recommends that the device, at a minimum, be able to accurately measure the speed of approaching and receding target vehicles over the range of 50 to 1,000 feet.

4. Lane Selectivity for Across-the-Road Devices

Requirement: For across-the-road devices, the operator must verify that target vehicles are being identified in the desired lanes of traffic and not in other lanes.

Rationale:

- Across-the-road devices will generally be used on roadways that have more than one lane of traffic.
- The active lanes, where speed readings may be taken, will depend upon the beam alignment.
- For proper target identification purposes, the operator needs to verify and note which traffic lanes are active at a particular setup location.

5. Electronic Circuits

Requirement: For both down-the-road and across-the-road devices, the operator must verify that the transmission, detection, timing, signal-processing, computation, and display circuits are in proper working order.

Rationale:

- Any piece of electronic equipment can malfunction.
- Malfunctions can cause erroneous speeds to be displayed.
- Each LSMD model has a specific procedure that needs to be followed to verify that the transmission, detection, timing, signal-processing, computation, and display circuitry are in proper working order.
- This verification procedure will help ensure that erroneous speed readings are not inadvertently obtained during the time that the LSMD is being used to measure target vehicle speeds.

B. Verification Procedure — An Example Using the LTI 20•20 Marksman

The LTI 20•20 Marksman is a down-the-road LSMD manufactured by Laser Technology, Inc. It is a hand-held device, powered by either a portable 12-volt rechargeable battery or a standard 12-volt power outlet in the patrol vehicle.

Nine principal components are needed for verification, as follows:

1) **Lenses:** Two lenses are located on the front of the device. The transmitted laser beam passes through one lens and the reflected light returns through the other.
2) **Sighting Scope:** The sighting scope is located on top of the device and incorporates a red dot to pinpoint the target vehicle while still providing the operator with a field-of-view to observe target vehicles.
3) **Trigger:** The trigger is located in the hand grip of the device and must be pulled each time a speed/distance reading is wanted.
4) **LED Readout:** The LED readout displays the speed of a vehicle coming toward or going away from the device. A minus sign precedes the numerical reading when the vehicle is receding. It also intermittently flashes a distance reading when that function is selected.
5) **Display Intensity:** The display intensity control knob is located near the display. It is used to adjust the brightness of the display and simultaneously, the brightness of the red sighting dot in the scope.
6) **Speed/Range:** The speed/range control button is located near the display and enables the operator to toggle between displaying speed and range. Speed readings will be a constant display, and range readings will flash.
7) **Test Mode:** The test mode control button is located near the display and enables the operator to verify that:
   - the scope and laser beam are properly aligned;
   - the light segments in the display are operable;
   - the transmission, detection, timing, signal-processing, and computation circuits are in proper working order.

8) **Power:** The power control knob is located near the display and is used to turn the device on and off. When the device is on and no speed or range readings are being displayed, a series of dash marks (- - - -) are displayed, indicating that the device has power and is on.

9) **Fuse:** The fuse is located in the power plug and serves to protect the LTI 20•20 Marksman in case the unit tries to draw too much current. Only fuses with ratings between 1.6 and 5.0 amps should be used.

The LTI 20•20 Marksman Verification Process requires the following four steps.

1. Self Test

The Self Test automatically takes place each time the instrument is turned on. The instrument interrogates each of the internal circuit boards. If everything is functioning properly, the display will show "8.8.8.8." briefly and then go blank. If anything other than this occurs, the instrument should be turned off and on again. If a problem persists, the device should be taken out of service.

2. Scope Alignment Test

Put the instrument in the test mode by pressing the test mode button on the back panel of the instrument. The display should read "tt."

- The instrument should emit an audible tone when the instrument's trigger is depressed. This tone should change pitch when the laser beam acquires a target. A telephone pole or similar object is an excellent target because one can aim the instrument skyward, eliminating anything in the background that could interfere with the test.
- When scanning across the telephone pole, the highest pitch or "on-target" tone will be heard when the device's laser beam is hitting the telephone pole. At this point, the scope's red dot should be on the test target telephone pole.
- This same procedure should be followed both vertically and horizontally. This test ensures the accuracy of the LTI 20•20 Marksman's targeting mechanics.
- This test is designed to ensure that the light beam of the laser is directed precisely where the red dot of the scope indicates. If the scope is out of alignment, the light beam will not be hitting the target vehicle. If this condition exists, the device should be taken out of service until the condition is corrected.

3. Display Test

To test that all segments of the display are functioning properly, press the "test' button and keep it depressed. When this button is pressed, all segments of the display will light up with "8.8.8.8." If any segment of the display is not functioning properly, the device should be taken out of service.

4. Accuracy Test

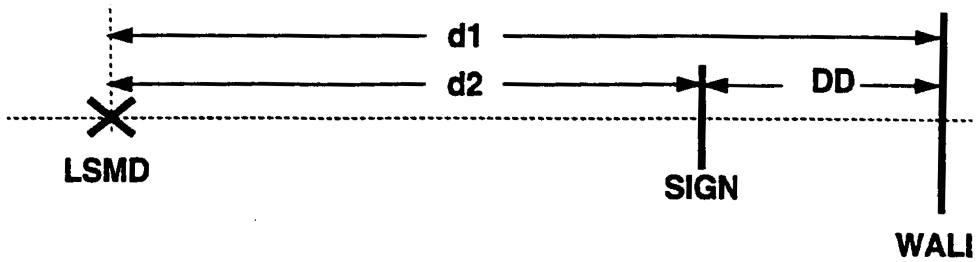
The accuracy test described below is also known as the "Delta-Distance Test." Successfully completing this accuracy test asserts that the instrument is measuring distances correctly and the time clock is functioning properly to accurately determine the speed of the target vehicles. If the instrument fails this test, it should be repeated once or twice. If it continues to fail this test, the device should be taken out of service until the condition is corrected.

The 7-step accuracy test procedure is described below:

1) Establish a known distance between three points that form a straight line. For example, this could be done in the agency parking lot using a sign, a wall, and a painted X on the ground. The officer would stand holding the LTI 20•20 Marksman directly over the X. The distances need to be measured with a tape measure between the X and the sign and between the X and the wall. For this example, let us assume that the distance between the X and the sign is 200 feet, and the distance between the X and the wall is 240 feet.
2) Stand holding the LTI 20•20 Marksman directly over the X.
3) Press the "test" button on the LTI 20•20 Marksman and keep it depressed until the "8.8.8.8." is displayed. Release the button and "t d1" (test distance 1) should now be displayed.
4) Now shoot a distance to the first reference point. The instrument should display the correct range to the first reference point within plus or minus one foot. For example, if the sign is the first reference point, the instrument should read 199, 200, or 201. The manner in which the officer stands, holds the instrument, etc., will have an effect on the distance measurement. The most accurate distance reading is obtained if the instrument is positioned directly over the X.
5) Push the "test" button again and "t d2" (test distance 2) will be displayed.
6) Now shoot a distance to the second reference point. The instrument should display the correct range to the second reference point, within plus or minus one foot. For example, if the wall is the second reference point, the instrument should read 239, 240, or 241. The manner in which the officer stands, holds the instrument, etc., will have an effect on the distance measurement. The most accurate distance reading is obtained if the instrument is positioned directly over the X.
7) Push the "test" button again and a flashing number will appear in the display. This number represents a simulated speed between the two reference points of 1 mph for every 6 inches between the two points.

In the foregoing procedure, the first distance is "200" feet and the second distance is "240" feet. Therefore, the distance between the sign and the wall is 40 feet. The speed reading is equivalent to 1 mph for every 6 inches so the speed reading will be "80" mph.

Delta-Distance Test for the LTI 20•20 Marksman LSM



Delta Distance (feet) = DD = (d1 - d2)
Expected Speed Reading (mph) = 2 (Expected DD)
Measured Speed Reading (mph) = 2 x (Measured DD)

Note: If the device fails any of the verification tests at the end of the shift, the operator shall take action to have all LSMD tickets that were issued during the shift dismissed.

7.8 Setup and Operation

Laser devices must be operated in the stationary mode only. It is important that a safe working location be chosen. This location must have a clear, unobstructed view to the section of road that will be targeted.

A. Down-the-Road Devices

1. Cosine-Effect Considerations

*See Section 6.6(A).

The angular (or cosine) effect on the laser is identical in nature to stationary-mode radar operation. Therefore, setup considerations are the same as with stationary radar.*

Note: This cosine effect will always produce a speed reading that is lower than the true target vehicle speed. Hence, this effect always favors the motorist.

2. Avoid Aiming through Patrol Vehicle's Windows

Because of the composition of window glass, including windshields, the use of the device through an unopened window in the patrol vehicle may significantly reduce its operation range. Please note that the glass does not affect the accuracy of the device, only its operational range.

B. Across-the-Road Devices

1. Assembly

Assemble the device according to the manufacturer's recommended procedure.

2. Beam Alignment

Align the laser beams according to the manufacturer's recommended procedures to achieve the following three objectives:

1) The two beams must be perpendicular to the motion of traffic.
2) A line drawn between the two beams at any distance from the device must be parallel to the roadway.
3) The two beams must only strike vehicles in the desired traffic lanes.

7.9 Target Tracking History

The elements that comprise the target tracking history differ for down-the-road laser devices and across-the-road laser devices.

Three elements comprise target tracking history for **down-the-road devices**:

1) Monitor traffic.
2) Aim the device at the license plate area of the vehicle.
3) Acquire the speed reading.

Two elements comprise target tracking history for **across-the-road devices**:

1) Monitor traffic.
2) Acquire the speed reading.

7.10 Factors Affecting Range

Three factors affect the range of both down-the-road and across-the-road devices:

1) **Brightness of vehicle color or finish:** The brighter the color, the longer the range. Red is very reflective and will allow longer ranges than the color black, which is the least reflective color. A shiny or clean finish will provide more range than a dull or dirty finish.
2) **Environment:** Rain, snow, fog, smoke, and smog in the air will generally reduce the operational range of the device. Please note that these environmental conditions do not affect the accuracy of the device, only its operational range.
3) **Dirty lenses:** Dirt or other deposits on the outer glass surfaces of the lenses protecting the internal optics of the LSMD may reduce range.

Additionally, down-the-road devices are affected by:

1) **Vehicle mass and shape:** The range will increase with increased target size. The range will be decreased for more aerodynamically shaped targets.
2) **Glass:** Use the device through an open side window. While glass does not affect the accuracy of the device, it does reduce its operational range.

The range for across-the-road devices will be affected if the laser beams are not be properly aligned.

7.11 Interference Effects

No mechanical interference effects due to the motion of fans, rotating wheels, windshield wipers or the like have been observed with laser devices. Likewise, no electromagnetic interference effects due to police radios, CB radios, radio or television transmitters, cellular phones, electronic ignitions, neon lights, or power lines have been observed with laser devices. However, a scanning effect is alleged to occur if the LSMD is moved in such a manner as to sweep across or pan an object. To minimize this effect, the operator should always hold the device steady while taking speed readings.

7.12 Diagnostic Messages

It is common practice today that LSMDs contain computers that control many of the functions and operation of the device. Typically, these devices also have computer programs that test the internal workings of the device and provide the user with diagnostic messages that indicate a particular condition.

Two types of diagnostic messages are common:

1) **Missed reading:** The operator attempted to make a speed reading, but the device was unable to acquire a valid speed reading.
2) **Device malfunction:** The LSMD displays a diagnostic message indicating that there is a device malfunction.

Each LSMD model will most likely possess its own unique set of diagnostic messages. The operator’s manual will contain a list and description of each of the messages.

As an example, the diagnostic messages for the Laser Technology, Inc. model LTI 20•20 Marksman are as follows:

- **E 01:** Never acquired a target either because the target was out of range or the target was too close. The minimum range the LTI 20•20 Marksman will target is 30 feet.
- **E 02:** Lost the target due to an obstruction or target went out of range.

Note: It is important that both lenses of the instrument be unobstructed. If the operator covers either lens, the instrument will produce an E 02 error message. If the car dash or the car's side mirror obstructs the path of the laser beam, the instrument will again produce an E 02 error message.

- **E 03:** Unstable reading due to poor aiming or panning off the target.

  Note: A distinct audio tone is also produced when any of the aforementioned diagnostic messages are produced. An experienced operator will be able to detect the message by "hearing it." Hence, without looking at the display, the operator will know that an accurate reading has not be acquired. There is no requirement in this situation to wait for any period of time. It is suggested that the operator simply maintain aim and pull the trigger again until a good reading is obtained.

- **E 50:** Indicates a device malfunction has been detected during either the device's self check or during operation. (If this diagnostic message persists, the device should be taken out of service until the condition has been repaired.)
- **Lo b:** Provides a visual alert that the device is not receiving sufficient electrical energy. (If this diagnostic message persists, the operator should check the electrical power connection and the power source and take corrective action.)

7.13 Repair Requirements

There is no requirement that LSMDs be taken out of service for periodic repair. A properly trained operator should be able to determine if a particular device should be taken out of service for repair.

A device should be taken out of service if any of the following conditions occur:

1) The device "misses" too many target vehicle speed readings for target vehicles that should have been within its operational range.
2) The device displays a diagnostic message indicating that there is a device malfunction.
3) The device fails one or more of the verification tests.

Note: If the device fails the verification tests at the end of the shift, the operator shall take action to have all LSMD tickets that were issued during the shift dismissed.

7.14 Review/Instructional Activities

The answers to the following questions appear in Section 7.15.

Questions

Choose the best answer for the following multiple choice questions.

1. Laser speed measurement devices can be operated in:

   a. the moving mode only.

   b. the stationary mode only.

   c. same-direction moving mode only.

   d. both the stationary and moving mode.

2. The Michigan Speed Measurement Task Force recommends that LSMDs be taken out of service for repair every six months.

   a. True   b. False

3. If the laser device fails the verification tests at the end of the shift, the operator must have all LSMD tickets that were issued during the shift dismissed.

   a. True   b. False

4. On a down-the-road laser device, the beam is directed:

   a. perpendicular to the motion of traffic.

   b. parallel to the motion of traffic.

   c. at a 45-degree angle to the motion of traffic.

   d. none of the above.

5. The beam width of a laser beam at 200 feet is the size of:

   a. A dime

   b. A wristwatch

   c. A headlight

   d. A stop sign

6. The Time-Distance Principle formula is:

   a. Speed = Ending Time + Starting Time

   b. Speed = Elapsed Time ÷ Distance Traveled

   c. Speed = Distance Traveled x Elapsed Time

   d. Speed = Distance Traveled ÷ Elapsed Time

7. An across-the-road laser device uses one laser light source.

   a. True b. False

8. The Michigan Speed Measurement Task Force has determined that the principal recommendations set forth in *People v Ferency* are applicable to cases involving LSMDs.

   a. True b. False

9. It is of particular importance that across-the-road laser devices be properly positioned and aligned, according to the MSMTF Guidelines.

   a. True b. False

10. One of the advantages of using laser instruments for speed monitoring as opposed to radar is:

    a. Laser devices are less expensive to purchase than radar equipment.

    b. The cosine effect is not a consideration with laser.

    c. Laser devices are able to single out individual vehicles more easily than radar.

    d. Laser devices are not subject to scanning effects.

11. For down-the-road devices, the MSMTF recommends that the device, at a minimum, be able to accurately measure the speed of approaching and receding target vehicles over the range of:

    a. 50-100 feet

    b. 500-1,000 feet

    c. 50-800 feet

    d. 50-1,000 feet

12. Which of the following steps is not part of the verification process for LSMDs?

    a. Speed Display Test

    b. Self Test

    c. Scope Alignment

    d. Accuracy Test

    e. Operational Range Check

13. Which of the following factors does NOT affect the operational range of a laser instrument?

    a. Rain, snow, fog, smoke, and smog

    b. Brightness of vehicle color

    c. Improper alignment of laser beams

    d. Glass

    e. Heavy traffic conditions

14. The cosine effect on a LSMD will always produce a speed reading that is:

    a. Lower than the true target vehicle speed.

    b. Higher than the true target vehicle speed.

    c. Identical to the true target vehicle speed.

15. Which of the following is recommended by the MSMTF in its guidelines for adjudicating laser speeding cases?

    a. The officer operating the LSMD must have adequate training.

    b. The LSMD must have been certified for use in Michigan.

    c. The target vehicle must be properly identified.

    d. All of the above.

16. Which of the following conditions does NOT require that a laser device be taken out of service?

    a. The device misses too many target vehicle speed readings for vehicles that should be within its operational range.

    b. The device displays spurious display readings.

    c. The device displays a diagnostic message indicating that there is a device malfunction.

    d. The device fails one or more of the verification tests.

17. If a laser device is aimed through the patrol vehicle's windshield, the accuracy of the device will be affected.

    a. True   b. False

18. For both down-the-road and across-the-road laser devices, which of the following does NOT need to be verified:

    a. Transmission

    b. Detection

    c. Patrol vehicle speed display

    d. Display circuitry

    e. Signal-processing

7.15 Answer Key

1. b	10. c
2. b	11. d
3. a	12. a
4. b	13. e
5. c	14. a
6. d	15. d
7. b	16. b
8. a	17. b
9. a	18. c

*On the following page, you will find a final review exercise. This will serve as your "final exam," incorporating material from all the units in this Manual. Before starting the final review, read the instructions on the next page, and view the videotape labeled "*Informal Hearings.*" Watch each of the three hearings on the videotape and answer the questions for that hearing before moving on to the next hearing.*